AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

1. (previously presented): An apparatus for estimating a magnetic pole position of a motor for a controlling apparatus for driving a motor by a voltage source PWM inverter, and controlling a torque, torque and speed, or torque, speed, and position of the motor, wherein

said apparatus comprises: means for switching over first means for producing an arbitrary phase difference in PWM carrier signals between respective two phases of three phases, and second means for causing the phase difference between the two phases to become zero;

means for extracting high-frequency currents in a same frequency band as carrier signals generated by it, from detected currents; and

means for estimating a magnetic pole position by using the extracted high-frequency currents.

2. (previously presented): An apparatus for estimating a magnetic pole position of a motor according to claim 1, wherein

said means for estimating a magnetic pole position by using the extracted high-frequency currents comprises:

means for extracting the high-frequency currents from respective phase currents of the three phases of said motor; means for converting the high-frequency currents to two-phase currents in a two-phase stationary coordinate system in which one of three-phase stator windings UVW is α-axis and an axis intersecting the α-axis at 90 deg. is β-axis; means for converting the high-frequency currents to two-phase currents in a two-phase stationary coordinate system in which a phase is similarly shifted by 45 deg. from said two-phase stationary coordinate system, or in which an axis that is shifted by 45 deg. from the α-axis is α'-axis and an axis intersecting the α'axis at 90 deg. is β'-axis; and

means for averaging the high-frequency currents in the four axes with a carrier frequency to calculate respective maximum values, and

estimates the magnetic pole position on a basis of the calculated maximum values in the four axes.

3. (previously presented): An apparatus for estimating a magnetic pole position of a motor according to claim 1, wherein

said means for estimating a magnetic pole position by using the extracted high-frequency currents comprises:

means for extracting the high-frequency currents from respective phase currents of the three phases of said motor; means for converting the high-frequency currents to two-phase currents in a two-phase stationary coordinate system in which one of three-phase stator windings

UVW is α-axis and an axis intersecting the α-axis at 90 deg. is β-axis; means for conducting conversion from the two-phase currents by using a magnetic pole estimated value in a two-phase rotating coordinate system in which γ-axis is in a same direction as the magnetic pole position, and an axis intersecting γ-the axis at 90 deg. is δ-axis;

means for converting the high-frequency currents to two-phase currents in a coordinate system in which a phase is similarly shifted by 45 deg. from said two-phase rotating coordinate system, such that a two-phase rotating coordinate system in which an axis that is shifted by 45 deg. from the γ-axis is γ'-axis and an axis intersecting the δ-axis at 90 deg. is δ'-axis; and means for averaging the high-frequency currents in the four axes with a carrier frequency to calculate respective maximum values, and

estimates the magnetic pole position on a basis of the calculated maximum values in the four axes.

4. (original): An apparatus for estimating a magnetic pole position of a motor according to claim 1, wherein

at least two or more currents are estimated during one carrier period.

5. (original): An apparatus for estimating a magnetic pole position of a motor according to claim 1, wherein

the arbitrary phase difference is 120 deg.

6. (previously presented): An apparatus for estimating a magnetic pole position of a motor according to claim 1, wherein

implementing time periods of said first means and said second means in said means for switching over said first means for producing an arbitrary phase difference in PWM carrier signals between respective two phases of three, and said second means for causing the phase difference between the two phases to become zero are set for purposes of adjusting amplitudes of generated high-frequency currents, and reducing a power loss.

7. (currently amended): An apparatus for estimating a magnetic pole position of a motor according to claim 1, wherein

said means for switching over said first means for producing an arbitrary phase difference in PWM carrier signals between respective two phases ~~such as UV, VW, or WU~~ of three ~~or UVW~~ phases, and said second means for causing the phase difference between two phases ~~such as UV, VW, or WU~~ of three ~~or UVW~~ phases to become zero comprises means for adjusting implementing time periods of said first means and said second means in accordance with a state of a load.

8. (currently amended): An apparatus for estimating a magnetic pole position of a motor according to claim 2, wherein

said means for estimating a magnetic pole position by using the extracted high-frequency currents is executed during an implementing time period of said first means for producing an arbitrary phase difference in the PWM carrier signals between respective two phases ~~such as UV, VW, or WU~~ of three ~~or UVW~~ phases is implemented, and, during an implementing time period of said second means for causing the phase difference between two phases ~~such as UV, VW, or WU~~ of three or ~~UVW phases~~ to become zero, is stopped, and uses a magnetic pole position estimated by said first means.

9. (currently amended): An apparatus for estimating a magnetic pole position of a motor according to claim 2, wherein

said means for estimating a magnetic pole position by using the extracted high-frequency currents is always implemented irrespective of implementing time periods of said first means for producing an arbitrary phase difference in the PWM carrier signals between respective two phases ~~such as UV, VW, or WU~~ of three ~~or UVW~~ phases, and said second means for causing the phase difference between two phases ~~such as UV, VW, or WU~~ of three or ~~UVW phases~~ to become zero,

comprises means for moving averaging the high-frequency currents in the four axes with a carrier frequency to calculate respective maximum values, and

estimates the magnetic pole position on the basis of the calculated maximum values in the four axes.

10. (original): An apparatus for estimating a magnetic pole position of a motor according to claim 2, wherein

the high-frequency currents of the α'- and β'-axes are calculated from the high-frequency currents of the α- and β-axes.

11. (currently amended): An apparatus for estimating a magnetic pole position of a motor according to claim 3, wherein

said means for estimating a magnetic pole position by using the extracted high-frequency currents is executed during an implementing time period of said first means for producing an arbitrary phase difference in PWM carrier signals between respective two phases ~~such as UV, VW, or WU~~ of three ~~or UVW~~ phases is implemented, and, during an implementing time period of said second means for causing the phase difference between two phases such as ~~UV, VW, or WU~~ of three ~~or UVW~~ phases to become zero, is stopped, and uses a magnetic pole position estimated by said first means.

12. (currently amended): An apparatus for estimating a magnetic pole position of a motor according to claim 3, wherein

said means for estimating a magnetic pole position by using the extracted high-frequency currents is always implemented irrespective of implementing time periods of said first means for producing an arbitrary phase difference in the PWM carrier signals between respective two phases ~~such as UV, VW, or WU~~ of three ~~or UVW~~ phases, and said second means for causing the

phase difference between two phases ~~such as UV, VW, or WU~~ of three ~~or UVW~~ phases to become zero,

comprises means for moving averaging the high-frequency currents in the four axes with a carrier frequency to calculate respective maximum values, and estimates the magnetic pole position on the basis of the calculated maximum values in the four axes.

13. (original): An apparatus for estimating a magnetic pole position of a motor according to claim 3, wherein

the high-frequency currents of the γ'- and δ'-axes are calculated from the high-frequency currents of the γ- and δ-axes.

14. (original): A controlling apparatus wherein said apparatus has a current controlling apparatus which splits an estimated current into a pole direction component and a torque component by using the magnetic pole position estimated by the apparatus for estimating a magnetic pole position according to claim 1, feeds back the components to obtain differences between the pole direction component and the torque component, and respect to current command values, and implements a current control so that the differences become zero.

15. (original): A controlling apparatus wherein said apparatus has a speed estimating apparatus which estimates a speed by using the magnetic pole position estimated by the apparatus for estimating a magnetic pole position according to claim 1.

16. (original): A controlling apparatus wherein said apparatus has a speed controlling apparatus which feeds back the speed estimated on the basis of the speed estimating apparatus according to claim 15, to obtain a difference with respect to a speed command value, and implements a speed control so that the difference becomes zero.

17. (original): A controlling apparatus wherein said apparatus has a position controlling apparatus which feeds back a rotor position estimated value which is obtained on the basis of the magnetic pole position estimated by the apparatus for estimating a magnetic pole position according to claim 1, to obtain a difference with respect to a rotor position command value, and implements a position control so that the difference becomes zero.

18. (original): A controlling apparatus wherein said apparatus has a torque controlling apparatus for a motor comprising the apparatus for estimating a magnetic pole position according to claim 1, and the current controlling apparatus according to claim 14.

19. (original): A controlling apparatus wherein said apparatus has a speed controlling apparatus for a motor comprising the apparatus for estimating a magnetic pole position according to claim 1, the current controlling apparatus according to claim 14, the speed estimating apparatus according to claim 15, and the speed controlling apparatus according to claim 16.

20. (original): A controlling apparatus wherein said apparatus has a position controlling apparatus for a motor comprising the apparatus for estimating a magnetic pole position according to claim 1, the current controlling apparatus according to claim 14, the speed estimating apparatus according to claim 15, the speed controlling apparatus according to claim 16, and the position controlling apparatus according to claim 17.